

# PATENT ABSTRACTS OF JAPAN

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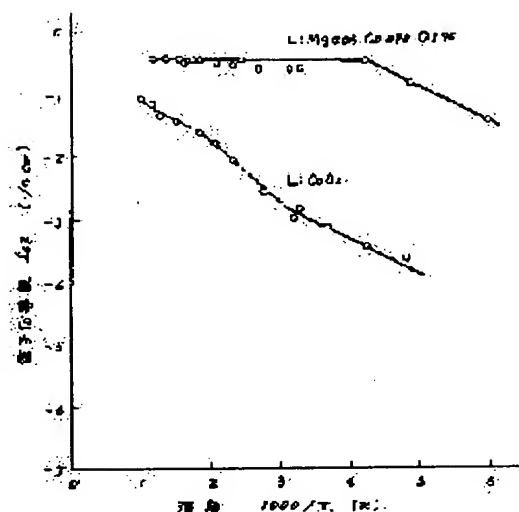
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## ) NONAQUEOUS ELECTROLYTE BATTERY

)Abstract:

RPOSE: To restrict reduction of a charge capacity in case of a high-rate discharge, and reduce deterioration of a discharge capacity if high-rate charges and discharges are repeated in case of a secondary battery displacing part of cobalt of  $\text{LiCoO}_2$  by magnesium.

INSTITUTION:  $\text{LiMg}_x\text{Co}_{1-x}\text{O}_{2-y}$  ( $0 < x < 1$ ,  $0 < y < 0.5$ ,  $x=2y$ ) obtained by placing part of cobalt in  $\text{LiCoO}$  by magnesium is used for positive electrode active material. In case of  $\text{LiMg}_{0.5}\text{Co}_{0.95}\text{O}_{1.75}$ , for example, an electron conductivity is improved by about 1000 times compared to that of  $\text{CoO}_2$ , and as a result of changing addition quantity of magnesium, the electron conductivity is improved in case that the value of (x) in  $\text{LiMg}_x\text{Co}_{1-x}\text{O}_{2-y}$  ( $0 < x < 1$ ,  $0 < y < 0.5$ ,  $x=2y$ ) is 0.04 or more. Reduction of a charge/discharge capacity at the time of a high-rate discharge can thus be reduced, and reduction of the charge/ discharge capacity after repeating cycles can be restricted in case of a secondary battery.



## LEGAL STATUS

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AIMS

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Example(s)  
Example 1] LiMg<sub>x</sub>Co<sub>1-x</sub> Nonaqueous electrolyte cell which used O<sub>2</sub>-y ( $0 < x < 1$ ,  $0 < y < 0.5$ ,  $x = 2y$ ) for positive active  
material.

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## TAILED DESCRIPTION

tailed Description of the Invention]

01]

ustrial Application] This invention relates to a nonaqueous electrolyte rechargeable battery.

02]

scription of the Prior Art] With the rapid formation of small lightweight of electronic equipment, it is small and the  
of a light weight and a high energy consistency is called for. As a cell which fills these demands, a nonaqueous  
trolyte cell is promising. It is  $\alpha$ -NaCrO<sub>2</sub> to positive active material especially. A type is stratified. LiCoO<sub>2</sub>  
ce a 4V class very high electrical potential difference is shown, the used nonaqueous electrolyte cell is expected as a  
of a high energy consistency.

03] However, LiCoO<sub>2</sub> is the matter (J. since it was van Elp et al. (44 Physi.Rev.B., 6090 (1991)), there was a trouble  
the internal resistance of a cell increased and discharge capacity fell at the time of high rate discharge.) of electric  
lation.

04]

ans for Solving the Problem] This invention is LiMgx Co 1-x. O<sub>2-y</sub> (0 < x < 1, 0 < y < 0.5, x=2y) Said problem is  
ved by using the nonaqueous electrolyte cell used for positive active material.

05]

nction] Artificers and LiCoO<sub>2</sub> If magnesium permutes some cobalt It found out that the electronic conduction nature  
iCoO<sub>2</sub> improved remarkably. That is, as shown in drawing 1, they are LiMg<sub>0.5</sub> Co 0.95O<sub>1.75</sub> of the new matter,  
LiCoO<sub>2</sub>. It compared and whenever [ electronic conduction ] improved by about 1000 times in ordinary  
perature. Moreover, as a result of changing and examining various magnesium additions, as shown in drawing 2, it  
iMgx Co 1-x. O<sub>2-y</sub> (0 < x < 1, 0 < y < 0.5, x=2y) When x values were 0.04 or more, it turned out that whenever  
ectronic conduction ] improves.

06] Thus, it is the lithium cobalt magnesium multiple oxide LiMgx Co 1-x of this invention as a result of the  
rovement of electronic conduction nature of the active material itself. O<sub>2-y</sub> (0 < x < 1, 0 < y < 0.5, x=2y) The  
aqueous electrolyte cell used for the active material Also when the fall of the discharge capacity at the time of high  
discharge was controlled so that it might be shown in the next example, and it is a rechargeable battery and high  
rge and discharge are repeated, there are few falls of discharge capacity.

07]

ample] Below, this invention is explained using a suitable example.

08] Positive active material was compounded as follows. A lithium:cobalt:magnesium atomic ratio is 1:(1-x):x about  
thium carbonate, tricobalt tetroxide, and a magnesium carbonate. Active material lithium cobalt magnesium multiple  
de LiMgx Co 1-x which mixes so that it may become, pyrolyzes in 16-hour air by temperature 900 \*\*, and is used  
the nonaqueous electrolyte cell of this invention O<sub>2-y</sub> (0 < x < 1, 0 < y < 0.5, x=2y) It compounded. Moreover, they are  
thium carbonate and tricobalt tetroxide at a lithium:cobalt atomic ratio 1:1 The active material which mixes so that it  
y become, pyrolyzes in 16-hour air by temperature 900 \*\*, and is used for the conventional nonaqueous electrolyte  
, and  $\alpha$ -NaCrO<sub>2</sub> The stratified lithium cobalt multiple oxide (LiCoO<sub>2</sub>) of a type was compounded.

09] They are the carbon powder as an electric conduction agent, and the fluororesin powder as a binder to the above-  
ntioned active material 90:3 : 7 It mixes by the weight ratio, 0.165g of this mixture is fed into electrode shaping  
tal mold, and, for a diameter, thickness is about 0.7mm at 16mm. It fabricated to disc-like. Vacuum-drying  
cessing of this Plastic solid was carried out by temperature 250 \*\*, and it considered as the positive-electrode plate.

10] A negative-electrode plate mixes a graphite and the fluororesin powder as a binder by the weight ratio of 91:9,  
the same metal mold as a positive-electrode plate is used for it for this mixture, and it is 0.5mm in the diameter of

mm, and thickness. After carrying out pressing, by temperature 250 \*\*, vacuum-drying processing was carried out it obtained.

11] The carbon button form cell as shown in drawing 3 using an above-mentioned positive-electrode plate and an above-mentioned negative-electrode plate was made as an experiment. Drawing is drawing of longitudinal section of a . The case which serves as the positive-electrode terminal which one in drawing pierced the stainless steel (SUS304) plate, and was processed, and 2 are stainless steel (SUSU304). It is the obturation plate which serves as the positive-electrode terminal into which the steel plate was pierced and processed, and the negative-electrode plate 3 is contacted by the wall. The separator which consists of polypropylene with which 5 sank in the organic electrolytic solution, and 6 are carrying out sealing obturation by binding tight the periphery of the obturation plate 2 which serves as negative-electrode terminal the open end of the case 1 which is a positive-electrode plate and serves as a positive-electrode terminal through a caulking and a gasket 4 to the inner direction.

12] What dissolved 6 fluoride [ phosphoric acid ] lithium in the solvent which mixed ethylene carbonate (EC), ethyl carbonate (DMC), and diethyl carbonate (DEC) by the volume ratio 2:2:1 by the concentration of one mol/l. used for the organic electrolytic solution. Furthermore, 10 ppm of lithium perchlorates were added to the electrolytic solution.

13] It is  $\text{LiMg}_x \text{Co}_{1-x} \text{O}_{2-y}$  ( $0 < x < 1$ ,  $0 < y < 0.5$ ,  $x=2y$ ) It is the used nonaqueous electrolyte cell of this invention, and they are (B) and the thing of  $x=0.08$  about (A) and the thing of  $x=0.05$  in the thing of  $x=0.03$  (C) and  $x=0.1$  A thing is called (D). Moreover, everything but having used  $\text{LiCoO}_2$  for positive active material calls (a) the comparison cell considered as the same configuration as the nonaqueous electrolyte cell of this invention.

14] Next, they are these cells Current density 2 mA/cm<sup>2</sup> It charges until terminal voltage results in 4.1V, and it continues, and, similarly they are 2 mA/cm<sup>2</sup>. Terminal voltage is 2.75V. It is charge-and-discharge cycle life test which charges until it reaches under a room temperature 100 Cycle \*\*\*\*\*. 2 mA/cm<sup>2</sup> By the nonaqueous electrolyte, it is very high current density. The discharge capacity in early stages of each cell and the discharge capacity after cycles are shown in Table 1.

15]

Table 1]

$\text{LiMg}_x \text{Co}_{1-x} \text{O}_{2-y}$ のx値	初期の放電容量	35サイクル目の 放電容量
A) $x=0.04$	130	90
B) $x=0.05$	150	140
C) $x=0.08$	150	130
D) $x=0.10$	125	70
E) $x=0$	120	40

e [ it is \*\*\*\*\* from Table 1 and ], compared with cell (a) for a comparison, an early discharge capacity of the cell of this invention, (B), (C), and (D) is large, and reduction of the discharge capacity after 35 cycles is also controlled.

16] In addition, although the organic electrolytic solution was used for the electrolytic solution in the above-mentioned example, using a carbon material as a negative electrode, it sets on the nonaqueous electrolyte cell of this invention, and it is  $\text{LiMg}_x \text{Co}_{1-x} \text{O}_{2-y}$  ( $0 < x < 1$ ,  $0 < y < 0.5$ ,  $x=2y$ ) If it uses for positive active material, neither a positive-electrode active material nor the electrolytic solution will be limited fundamentally. That is, the negative-electrode active material used for the conventional nonaqueous electrolyte cell, for example, a pure lithium, a lithium alloy, etc. can be used for a negative-electrode active material. Moreover, independent or two sorts or more may be added to the electrolytic solution, and ether, such as cyclic ester, such as other organic solvents, for example, ethylene carbonate, and propylene carbonate, and a tetrahydro furan, and dioxolane, may be used for it. Or an organic solid electrolyte and an inorganic solid electrolyte may be used for an electrolyte. Similarly, the quality of the material of a supporting electrolyte, a separator, an electrode base, and a cell case etc. is not limited fundamentally.

17] In addition, although the cell concerning the aforementioned example is a carbon button cell, the same effectiveness is acquired even if it applies this invention to a cylindrical shape, a square shape, or a paper form cell. Moreover, the effectiveness of raising the high-rate-discharge engine performance is not only the rechargeable battery

n example but  $\text{LiMg}_x\text{Co}_{1-x}\text{O}_{2-y}$  ( $0 < x < 1$ ,  $0 < y < 0.5$ ,  $x=2y$ ) In the used nonaqueous electrolyte primary cell, it is defined similarly.

[8]

ect of the Invention] Like \*\*\*\*, the nonaqueous electrolyte cell of this invention has few falls of the discharge capacity at the time of high rate discharge, and when it is a rechargeable battery, it is effective in reduction of the charge capacity after repeating a cycle being controlled.

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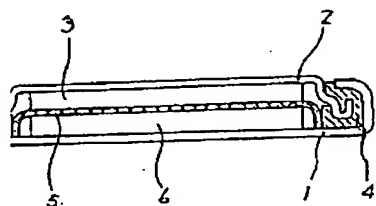
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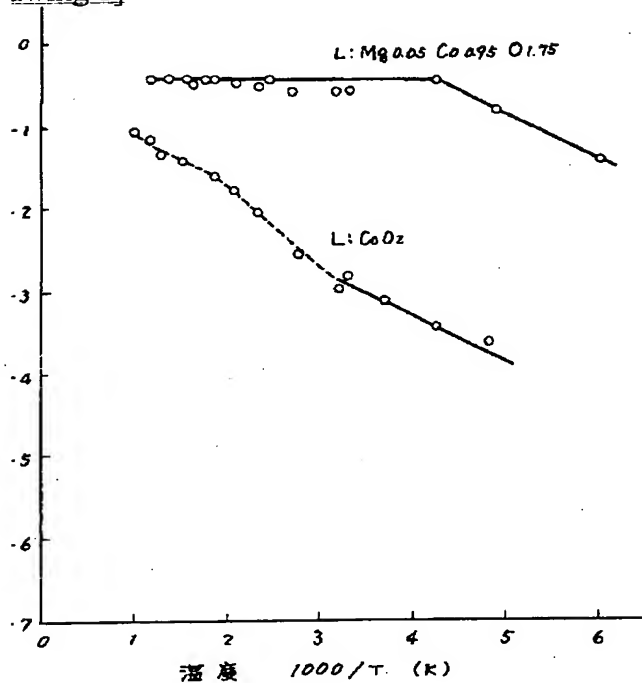
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## AWINGS

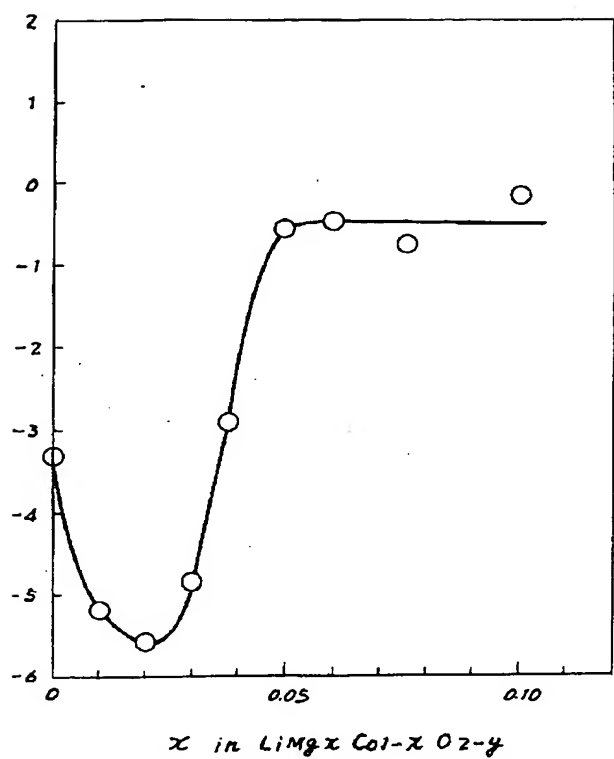
awing 3]



awing 1]



awing 2]



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